NOTES ON THE *GAYLUSSACIA DUMOSA* COMPLEX (ERICACEAE)

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ABSTRACT

Four taxa in the *Gaylussacia dumosa* complex are reviewed, using morphologic and habitat characters. Most morphologic characters overlap to some degree, but all taxa are readily separable by using character suites. *Gaylussacia dumosa* is widespread; the other three taxa have relatively narrow ranges and are separated geographically, but each is partly sympatric with G. dumosa. There is no overlap in habitat; syntopy is unknown. We recognize all four of these entities as full species: *G. dumosa* (Andrews) Torr. & A. Gray, *G. mosieri* Small, *G. orocola* (Small) Camp, and **Gaylussacia bigeloviana** (Fern.) Sorrie & Weakley comb. nov.

RESUMEN

Se revisan cuatro taxa del complejo *Gaylussacia dumosa*, usando caracteres morfológicos y del hábitat. La mayoría de los caracteres morfológicos tienen algún grado solapamiento, pero todos los taxa son fácilmente separables usando series de caracteres. *Gaylussacia dumosa* es una planta común; los otros tres taxa tienen areales relativamente pequeños y están separados geográficamente, pero todos son parcialmente simpátricos con G. dumosa. No hay solapamiento en el hábitat; la sintopía es desconocida. Reconocemos a las cuatro entidades como especies: *G. dumosa* (Andrews) Torr. & A. Gray, *G. mosieri* Small, *G. orocola* (Small) Camp, y **Gaylussacia bigeloviana** (Fern.) Sorrie & Weakley comb. nov.

INTRODUCTION

The *Gaylussacia dumosa* complex includes four related taxa of dwarf to one-meter tall shrubs of eastern North America. These taxa may be distinguished from other members of the genus by the persistent inflorescence bracts longer than the pedicels (vs. early-deciduous and shorter than the pedicels) and by stipitate-glandular sepals, pedicels, bracts, and leaves (vs. sessile-glandular). *Gaylussacia dumosa* (Andrews) Torr. & A. Gray was described in 1843 (Torrey & Gray 1843); *G. dumosa* var. *bigeloviana* in 1911 (Fernald 1911); *G. mosieri* Small in 1927 (Small 1927), originally named *G. dumosa* var. *hirtella* Chapman (Chapman 1860); and *G. orocola* (Small) Camp in 1935, originally described as *Lasiococcus orocola* Small (Small 1933). While the first three taxa have been recognized by many authors, the very locally distributed *G. orocola* has met with less general acceptance and has often been synonymized within *G. dumosa* by authors of floristic treatments.

Camp (1935, 1941) recognized *Gaylussacia dumosa* (including "*bigeloviana*" without rank), *G. mosieri,* and *G. orocola* at species level. In his monograph of the genus *Gaylussacia*, Sleumer (1967) followed Camp's taxonomy, using morphologic characters. Authors of northeastern floras, such as Fernald (1950) and Gleason and Cronquist (1990), recognized *bigeloviana* as a variety within *G. dumosa*. Southeastern authors, such as Radford, Ahles, and Bell (1968), included var. *bigeloviana* as a synonym of *G. dumosa*, if they mentioned it at all. Radford, Ahles, and Bell also synonymized "*orocola*" without rank within *G. dumosa*. In the most recent study, Floyd (2002) analyzed DNA and morphologic characters genus-wide. She recognized three species within the *G. dumosa* group: *G. dumosa*, *G. mosieri,* and *G. orocola*. However, she did not collect specimens of *G. orocola* for DNA sampling. Also, Floyd apparently elected not to recognize var. *bigeloviana*; she did not discuss it and it is unclear if she included specimens of that variety within her analyses of *G. dumosa*. These omissions are unfortunate, for the inclusion of var. *bigeloviana* in her work may have helped to resolve its taxonomic position, and the absence of DNA data from *G. orocola* weakens her conclusion that it stands apart from *G. dumosa* and *G. mosieri*.

Overall, the *G. dumosa* complex ranges from Newfoundland south to Florida and west to Louisiana, inland to the Appalachian Mountains and Cumberland Plateau. The distribution and habitats of *G. mosieri* and *G. dumosa* have been fairly well worked out, but problems have remained regarding *G. orocola,* due to

a paucity of specimens and due to imprecise knowledge of the taxonomic limits between it and *G. dumosa* var. *bigeloviana*. Problems also have remained between G. *dumosa* var. *bigeloviana* and var. *dumosa,* because of imprecisely described taxonomic limits and alleged hybridization within a broad area of sympatry (Fernald 1950; Gleason 1952; Gleason & Cronquist 1990). In this paper we set forth criteria for distinguishing these taxa, present a taxonomy of the group, and provide county-level distribution maps.

METHODS

We examined over four hundred herbarium specimens from CLEMS, DUKE, IBE, NCSC, NCU, USCH, VA, VPI, and WILLI, and selected specimens from GH. We assessed morphological characters that have been traditionally used in *Gaylussacia*, such as glandular hairs on the calyx, as well as new characters, such as corolla length. Five measurements were made of each character per specimen, from at least ten specimens across the range of each taxon. The distribution maps were prepared from herbarium specimens plus records from the following sources: Alabama—Clark (1971), Florida—atlas of Florida vascular plants (http://www.plantatlas.usf.edu), Georgia—Duncan and Brittain (1966) and Jones and Coile (1988), Tennessee—Chester et al. (1997). Maps of Delaware, Maryland, New Jersey, New York, and Pennsylvania were prepared from specimens plus data from state Natural Heritage Program botanists (see discussion under Distribution below).

RESULTS AND DISCUSSION

Distinguishing characters

Our analyses revealed several useful morphological characters (Table 1). These are: plant height, corolla length, anther length, density and length of glandular hairs on the hypanthium, density and length of non-glandular hairs on the leaf margin, and presence of sessile glands on the upper leaf surface. Habitat, when accurately described on specimen labels, is a valuable distinguishing character. Other characters have been used by various authors, but are not utilized here. For example, the more-or-less virgate and relatively few branches of *G. dumosa* var. *dumosa* (vs. numerous spreading branches in the other three taxa), while useful in the field, can be difficult to apply to herbarium specimens. Small's description of *G. orocola* states that the leaves possess stellate hairs; this is a unique character when present, but we found such hairs to be so sparse (completely lacking on many leaves) that its use as an identification character was untenable. Size of mature fruit may be a useful character in living plants, but the squashed fruits on dried specimens are highly variable in dimensions.

Table 1 compares morphological characters of the four members of the *Gaylussacia dumosa* complex. We briefly discuss each character.

1. Plant height. *Gaylussacia dumosa* var. *dumosa* is the only dwarf shrub of the group, seldom exceeding 0.3 m. The other three taxa usually exceed 0.5 m and may reach 1 m tall. However, var. *bigeloviana* may occasionally overlap var. *dumosa* in height, and presumably short-statured plants have caused identification problems in the purported area of overlap from Virginia to New York.

2. Corolla length. *Gaylussacia mosieri* and var. *bigeloviana* have distinctly longer corollas than the other two taxa. *G. orocola* is unique in combining tall plant height with small corolla and anther size.

3. Anther length. This character follows that of corolla length: two taxa with long anthers and two with short anthers.

4. Hypanthium glandular hairs. The greater density and length of glandular hairs on *G. mosieri* (1.0–1.5 mm, twice as long as in other taxa) are obvious on dried specimens as well as on living plants. *G. dumosa* var. *dumosa* has the least dense and shortest hairs (0.2–0.3 mm), although some individuals may be difficult to distinguish from var. *bigeloviana* and *G. orocola* (0.3–0.5 mm).

5. Leaf margin hairs (non-glandular). *Gaylussacia orocola* and var. *bigeloviana* clearly have denser marginal hairs than the other two taxa: 6–9 hairs per mm of leaf margin and 7–10 hairs, respectively, vs. 1–2 hairs per mm in *G. mosieri* and 2–5 hairs per mm in *G. dumosa*. Leaf margin hairs are nearly or entirely absent in many *G. dumosa* and *G. mosieri* plants.

6. Sessile glands on upper leaf surface. *G. mosieri* is unique in lacking them, while the other three taxa usually have large numbers.

Taxonomy

Based on original morphological and ecological analyses, we recognize all four taxa at species rank. In doing

TABLE 1. Comparison of characters among four North American taxa of *Gaylussacia*.

	G. mosieri	*G. bigeloviana*	*G. orocola*	*G. dumosa*
Plant height	0.5–1.0(–1.5) m	(0.2–)0.4–1.0 m	0.4–1.0 m	0.1–0.3(–0.4) m
Corolla length	7.0–8.5 mm mean 7.41 mm SD = 0.80	6.5–8.0 mm mean 7.06 SD = 0.46	5.5–6.5 mean 5.96 SD = 0.47	5.3–6.5 mean 5.78 SD = 0.53
Anther length	3.3–4.3 mm mean 3.88 mm SD = 0.28	3.2–4.2 mean 3.73 SD = 0.35	2.5–3.2 mean 2.85 SD = 0.26	2.8–3.1 mean 3.02 SD = 0.07
Density and length of glandular hairs on hypanthium	very dense; 1.0–1.5 mm	dense; 0.3–0.5	moderate to dense; 0.3–0.5	moderate; 0.2–0.3
Density and length of non-glandular hairs on leaf margin	1–2 per mm of leaf margin; up to 0.5 mm long	7–10 per mm; up to 0.3 mm long	6–9 per mm; up to 0.3 mm long	2–5 per mm; up to 0.3 mm long; often absent
Sessile glands on upper leaf surface	none	numerous	numerous	numerous; sometimes absent
Habitat	seepage bogs, wet flat woods, baygalls, ecotones of streamheads	peat bogs, boggy cedar-maple swamps, peat-based pocosins within Carolina bays	montane sphagnous bogs, seepage over granite	xeric to dry pine-oak uplands and sandhills, dry to wet pine savannas and flatwoods, oak barrens, oak heaths

so, we parallel the work of Luteyn et al. (1996), who treated the three members of the *Gaylussacia frondosa* (L.) Torr. & A. Gray group at species rank. In the *G. frondosa* group, there is a relatively widespread coastal plain/piedmont species plus two southeastern coastal plain endemics. In the case of the *G. dumosa* group, there is one widespread "core" species, *G. dumosa*, with three other species that, while well separated from each other, are partially sympatric with *G. dumosa* (Figs. 1–4). Each of the three segregates is sharply separated from *G. dumosa* by habitat, and in the case of *G. orocola*, mostly by elevation as well.

We have had little difficulty in identifying herbarium specimens, whether flowering, fruiting, or simply vegetative, by utilizing a suite of characters (see Table 1 and above discussion) that renders each species unique. Some poorly-collected specimens with vague habitat data can be difficult to identify. By employing several characters per specimen, identification errors are greatly reduced. Moreover, we refute the assertion that there is a broad zone of intermediacy (Long Island, New York to Virginia) involving *G. dumosa* and *G. bigeloviana*; instead, our data suggest that identification characters used in previous works were inadequate or were partly based on misidentified specimens.

The choice to treat the complex as four species deserves some comment. *Gaylussacia mosieri* has generally been accorded specific distinction from the other three, while *G. dumosa* var. *dumosa* and var. *bigeloviana* have generally been regarded as only varietally distinct from one another. *Gaylussacia orocola* has often been included in *G. dumosa* var. *dumosa*. Two characters appear to separate *G. mosieri* from the other three taxa: length and density of hairs on the hypanthium and absence of sessile leaf glands on the upper leaf surface. However, other characters suggest variable and shifting groupings of the taxa (see Table 1). For example, corolla size and anther length would ally *G. mosieri* and *G. dumosa* var. *bigeloviana* on the one hand and *G. orocola* and *G. dumosa* var. *dumosa* on the other. Habitat and stature would suggest that *G. dumosa* is the outlier from the other three, being the shortest and occupying the driest habitats. We therefore conclude that the

most practical treatment is to consider the four taxa to have equal taxonomic rank. Some taxonomists may suggest that the taxa should be given varietal status, because they may view the morphological characters as relatively subtle, because some of the taxa have traditionally been treated at that level or not recognized at all, and because of the existence of occasional ambiguous herbarium specimens. However, the differences exhibited between taxa is greater than that usually accorded varieties, which normally involves only one or two minor morphological traits and often a geographical component (Grant 1981). Here, the four taxa are differentiated by combinations of habit, corolla and anther size, vestiture, presence/absence of sessile glands on upper leaf surface, habitat, and range. The *Gaylussacia* taxa treated here fit the morphological, or taxonomic, species concept (Grant 1981; Stuessy 1990). While we suspect that the four taxa probably represent distinct evolutionary lineages, thus fitting the concept of phylogenetic species, the data of Floyd (2002) are inconclusive. Moreover, additional evidence from biochemical and crossing studies are desirable.

Names at species rank exist for three of the taxa; here we raise *G. dumosa* var. *bigeloviana* Fernald to species status.

Gaylussacia bigeloviana (Fernald) Sorrie & Weakley, comb. nov. BASIONYM: *Gaylussacia dumosa* (Andrews) Torr. & A. Gray var. *bigeloviana* Fernald, Rhodora 13:95–99. 1911. Type: U.S.A. MAINE. Washington Co.: heath at base of West Quoddy Head, Lubec, 26 Jul 1909, *M.L. Fernald 2038 with K.M. Wiegand* (HOLOTYPE: GH!).

KEY

1. Plant ≤ 3 dm high.
   2. Corollas 6.5–8.0 mm long, averaging 7.0 mm; anthers 3.2–4.2 mm long, averaging 3.7 mm; glandular hairs on hypanthium dense, 0.3–0.5 mm long; non-glandular hairs on leaf margin dense; plants usually 4–10 dm high, rarely less than 3 dm; plants of wet boggy habitats; northeastern range, south to DE, disjunct to NC and SC _____ **G. bigeloviana**
   2. Corollas 5.3–6.5 mm long, averaging 5.8 mm; anthers 2.8–3.1 mm long, averaging 3.0 mm; glandular hairs on hypanthium moderately dense to relatively sparse, 0.2–0.3 mm long; non-glandular hairs on leaf margin sparse to absent; plants occasionally up to 4 dm high; plants of xeric to moist habitats; southeastern range, north to VA (rare MD) and scattered inland to n AL, n GA, c TN, w SC, w NC, and s WV _____ **G. dumosa**
1. Plant > 4 dm high, ranging up to 10 dm, occasionally to 15 dm.
   3. Sessile glands on upper leaf surface absent; glandular hairs on hypanthium 1.0–1.5 mm long; East Gulf Coastal Plain endemic, sw GA-n FL-s AL-s MS-se LA _____ **G. mosieri**
   3. Sessile glands on upper leaf surface numerous; glandular hairs on hypanthium 0.3–0.5 mm long; ranging from SC northward.
      4. Corollas 6.5–8.0 mm long, averaging 7.0 mm; anthers 3.2–4.2 mm long, averaging 3.7 mm; plants of peat bogs, raised bogs, peat-based pocosins, and Atlantic white cedar-red maple swamps; ranging from Newf. to DE, and as a rare disjunct in the Coastal Plain of NC and SC _____ **G. bigeloviana**
      4. Corollas 5.5–6.5 mm long, averaging 6.0 mm; anthers 2.5–3.2 mm long, averaging 2.9 mm; plants of montane bogs and seepage over rock; rare endemic of southern Appalachians of w NC _____ **G. orocola**

Habitat

Gaylussacia dumosa normally inhabits much drier sites than the other three species. It is most abundant in xeric to mesic pine-oak sandhills, pine-oak-hickory woodlands, and oak barrens, but also occurs in moist to seasonally wet longleaf pine savannas and flatwoods.

Gaylussacia mosieri inhabits seepage bogs (often called hillside bogs), margins of streamheads and baygalls (often with Atlantic white cedar, *Chamaecyparis thyoides* (L.) B.S.P.), and wet pine flatwoods. These seepages are minerotrophic and do not accumulate peat; therefore they are best termed poor fens. *Gaylussacia mosieri* may occur in disturbed habitats (roadside scrapes, borrow pits) that superficially appear dry, but which are underlain by a claypan.

From Delaware northward, Gaylussacia bigeloviana inhabits peat bogs (including ombrotrophic raised bogs), sphagnum-shrub bogs, and boggy red maple (*Acer rubrum* L.)-Atlantic white cedar swamps. It may also occur in disturbed habitats (roadside scrapes, borrow pits) that superficially appear dry at some seasons, but which are underlain by high water tables. In North Carolina, *G. bigeloviana* occurs in several large pocosins, which are peat-based ombrotrophic bogs dominated by ericaceous shrubs and scattered pond pines (*Pinus serotina* Michx.). These pocosins occur in the outer coastal plain within Carolina bay depressions and in

extensive interstream flats (Weakley & Schafale 1992). In South Carolina, *G. bigeloviana* inhabits a seepage wetland dominated by Atlantic white cedar.

The primary habitat of *G. orocola* is peaty montane bogs at moderate elevations in the southern portion of the Appalachians, notably the bogs of the East Flat Rock area, Henderson and southern Buncombe counties, North Carolina; these wetlands have been largely destroyed and few remnants remain (Weakley & Schafale 1994). Specimen label data suggests that *G. orocola* may also occur in seepage over sloping exposures of granitic rock. These bogs harbor endemic taxa as well as disjuncts from the Coastal Plain. Among the endemics are *Sarracenia jonesii* Wherry and *Sarracenia purpurea* Linnaeus var. *montana* Schnell & Dietermann. Coastal plain disjuncts include *Chamaedaphne calyculata* (L.) Moench, *Myrica gale* L., *Helonias bullata* L., *Juncus caesariensis* Coville, and *Eriocaulon decangulare* L.

Distribution

Gaylussacia mosieri is endemic to the East Gulf Coastal Plain from Coffee County, Georgia, and Taylor County, Florida, west to Tangipahoa Parish, Louisiana (Fig. 1). One outlying record is from Duval County, Florida (Curtiss 1660 GH, mixed sheet with *G. dumosa*). All populations occur within 250 km of the Gulf of Mexico.

Gaylussacia orocola is endemic to the Southern Appalachian Mountains of western North Carolina, in Buncombe, Henderson, Jackson, Macon, and Transylvania Counties (Fig. 2, Appendix 2). This area supports a concentration of "southern Appalachian bogs," many now altered or destroyed.

Gaylussacia bigeloviana is distributed on the Atlantic seaboard from Newfoundland south to Delaware, disjunct to North and South Carolina (Fig. 3). Extreme inland records—maximum 120 km from saltwater—are in York County, Pennsylvania, and Prince George's Counties, Maryland, but these are near Chesapeake Bay, a major estuary of the ocean. Specimens at USCH collected from Atlantic white cedar swamps in Lexington County in central South Carolina, were annotated by Wilbur and Whitehead to *G. dumosa* var. *bigeloviana*; we concur. The specimens have unusually large leaves (ranging from 1×2.5 cm to 2×5 cm), possibly a result of growing in shady conditions. Corolla length, anther length, and leaf margin hair density are typical for *bigeloviana*, but hypanthium glandular hairs are longer than usual, ranging from 0.6–1.0 mm.

Gaylussacia dumosa occurs from Virginia and West Virginia to south Florida, west to East Feliciana Parish, Louisiana (Fig. 4). We have seen one specimen from Maryland (cited below). Although predominantly a species of the coastal plain, there are many inland records from the piedmont and even montane provinces of northern Alabama, central Tennessee, etc. We list selected inland records in Appendix 1. Various manuals have ascribed a range north to Long Island, New York, but we have seen only one correctly identified specimen of *G. dumosa* from north of Virginia. Fernald (1911, 1950) and Gleason (1952) suggest that there is much intermediacy between *dumosa* and *bigeloviana* in the region from Long Island to Virginia. For example, Gleason (1952) states that "Intermediate plants are plentiful between Va. and Long Island." In contrast, we have observed virtually no intermediacy in specimens from this region. Here we discuss the status of *G. dumosa* in these states.

New York. Mitchell and Tucker (1997) synonymized "*bigeloviana*" within *G. dumosa* without discussion; the inclusive *G. dumosa* has been documented only on Long Island and Staten Island. Stephen Young of the New York Natural Heritage Program has observed and collected only *G. bigeloviana*, all in boggy habitats (pers. comm.).

New Jersey. The inclusive *G. dumosa* has been documented from Monmouth County south to Cape May and Cumberland Counties (Stone 1911). Stone stated that "I fail to distinguish the variety *bigeloviana*, proposed by Prof. Fernald..." He could hardly come to another conclusion, since there is no verified specimen of *G. dumosa* sensu stricto from New Jersey; all specimens we have seen are *G. bigeloviana*. David Snyder of the New Jersey Natural Heritage Program has observed and collected only *G. bigeloviana*, all in boggy habitats within the Pine Barrens (pers. comm.).

Pennsylvania. Rhoads and Klein (1993) listed *G. dumosa* without synonymy and mapped it in Lancaster, Montgomery, Northampton, and York Counties. The habitat is given as "moist, acidic woods and

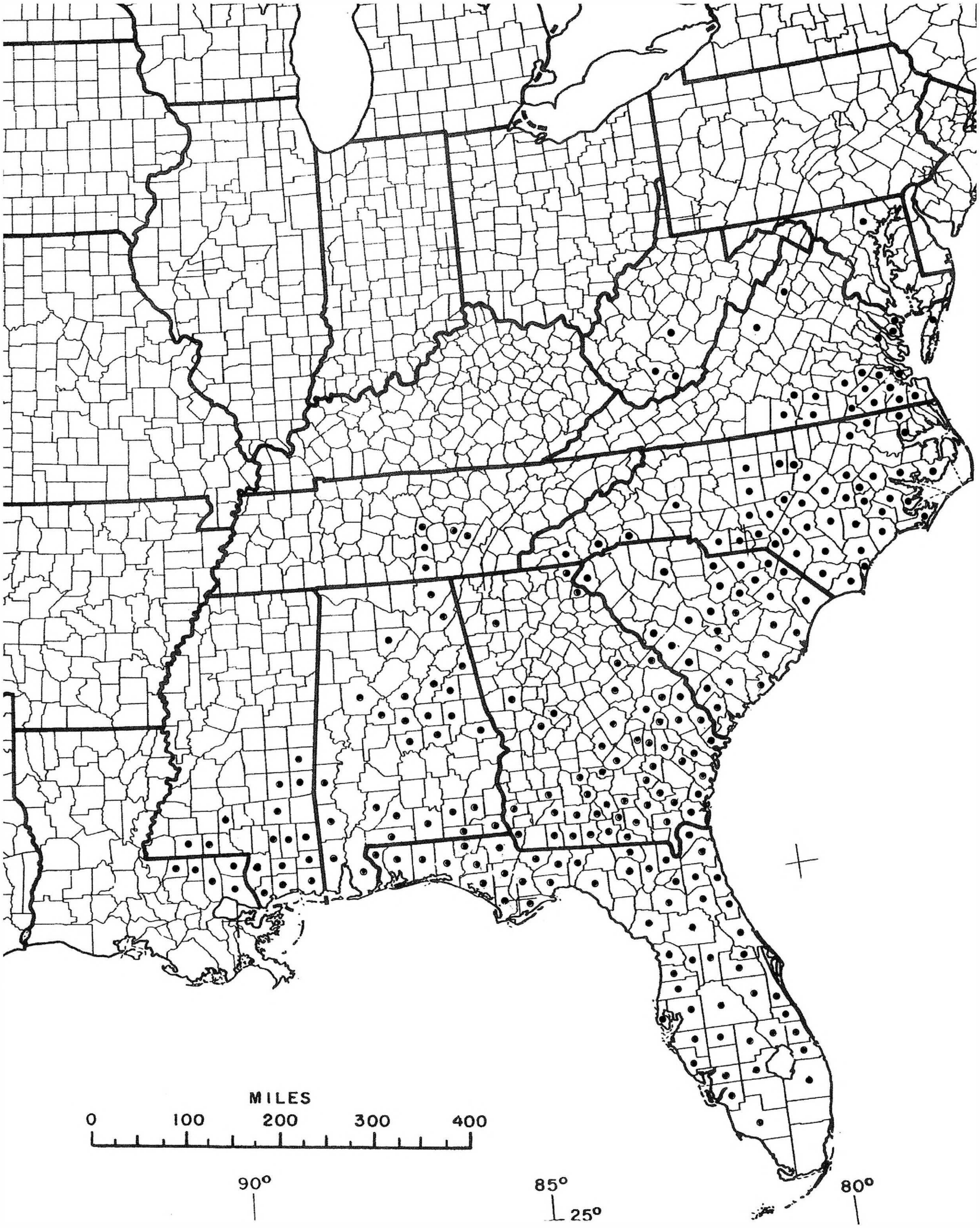

Fig. 1. County level distribution map of *Gaylussacia dumosa,* based on specimens and selected sources.

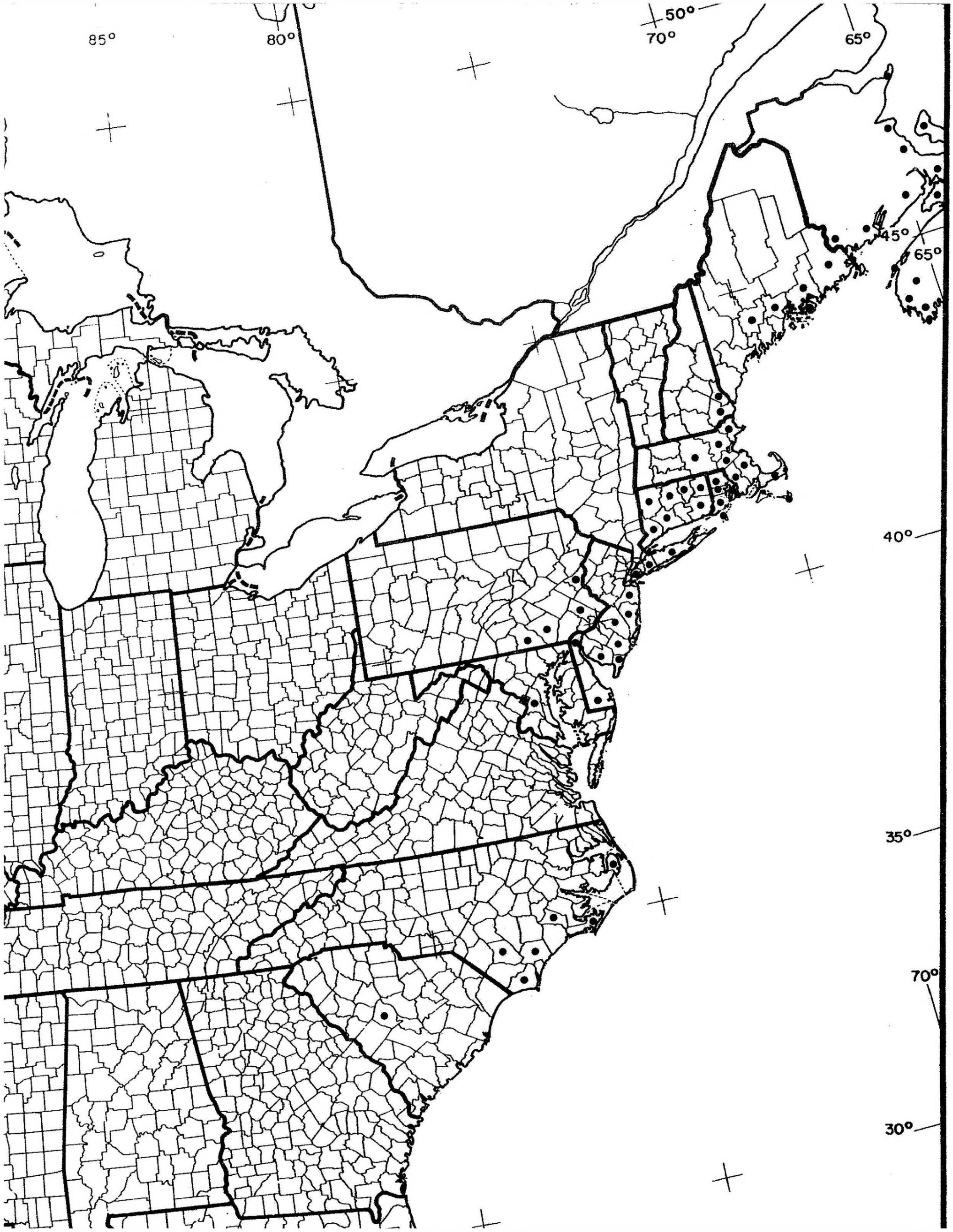

Fig. 2. County level distribution map of *Gaylussacia bigeloviana,* based on specimens and selected sources.

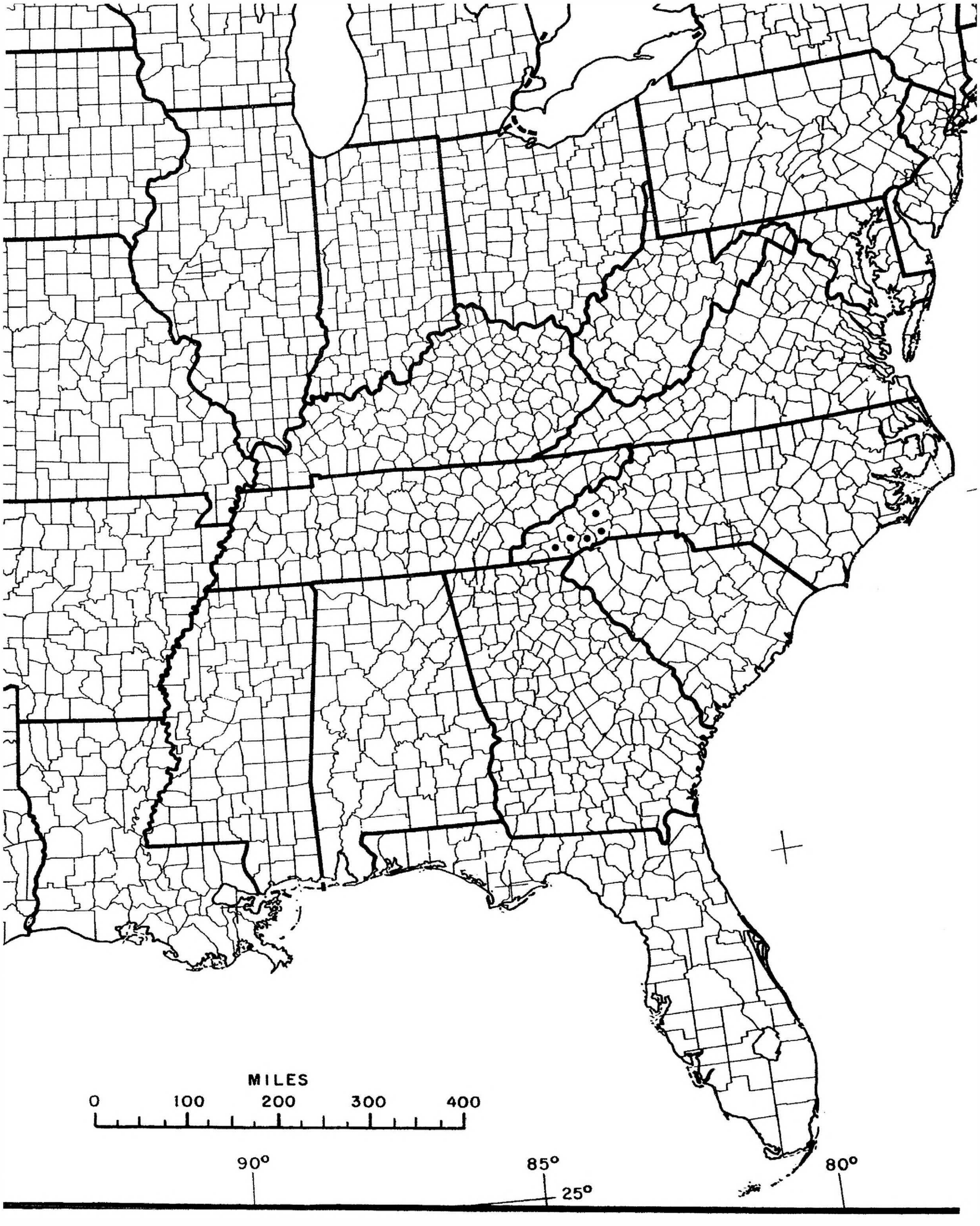

Fig. 3. County level distribution map of *Gaylussacia orocola,* based on specimens and selected sources.

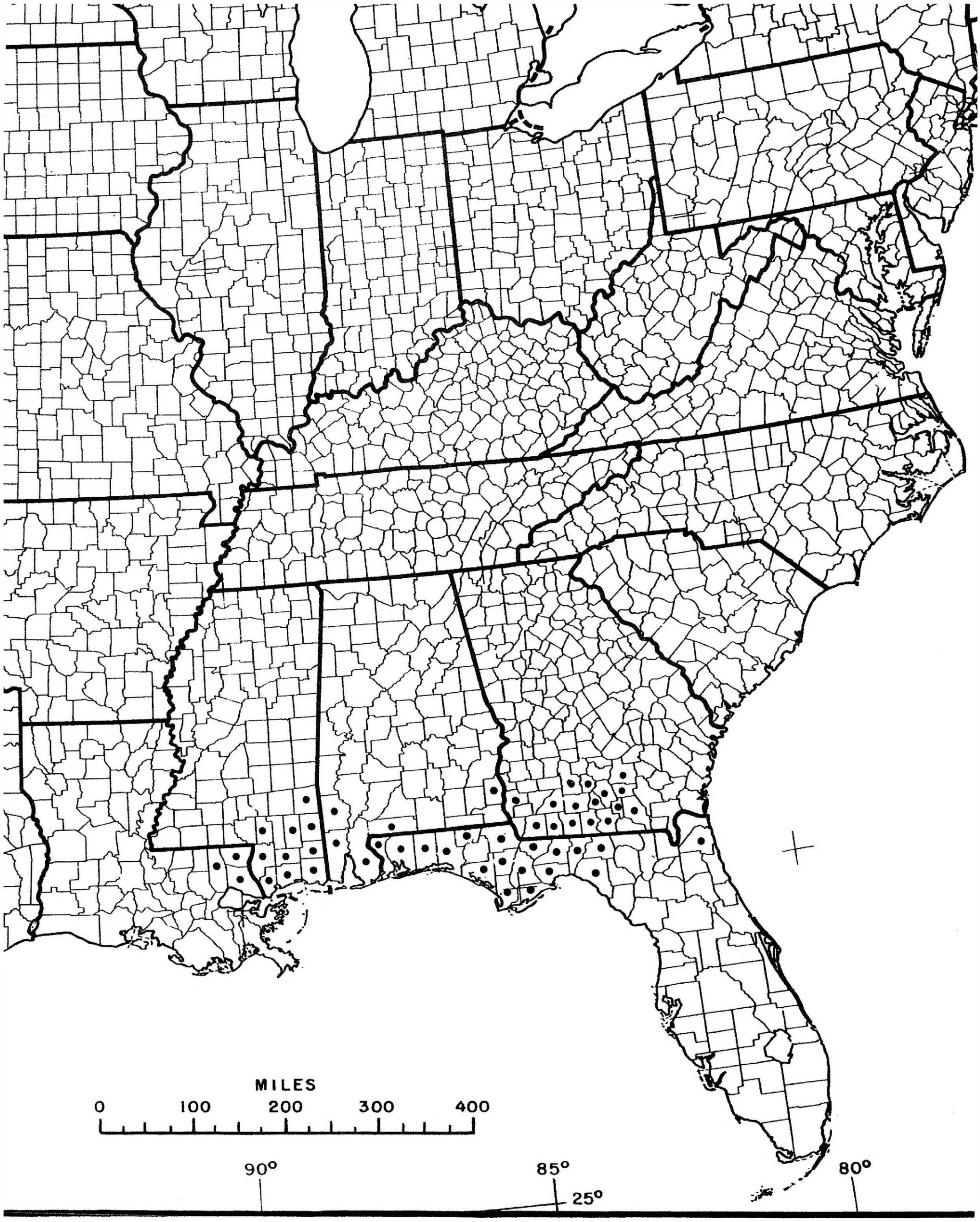

FIG. 4. County level distribution map of *Gaylussacia mosieri,* based on specimens and selected sources.

swamps." Small (1894) also reported Pennsylvania plants from wet habitats: "At the Pennsylvania localities the plant grows in swamps, and at Smithville [Lancaster County] is actually in the water..." We believe that all Pennsylvania records refer to *G. bigeloviana*.

Maryland. Brown and Brown (1992) listed *G. dumosa* without synonymy and state that it inhabits "Moist to dry, sandy soils of the Coastal Zone; recorded from the Mountain Zone by Shreve." The text description appears to be a composite of both *dumosa* and *bigeloviana*. A specimen from Baltimore County—glade of transmission line east of Pulaski Highway, Baltars 1824 (DUKE)—is *G. dumosa*. The Maryland Native Plant Society website (www.mdflora.org/survey_data/JMPMontCoPlantsAddendum.html) lists old records from Takoma (Montgomery County) and Powdermill Bogs (Prince George's County), adjacent to the District of Columbia; no variety is indicated. In May of 2006, two specimens from Prince George's County were examined by Chris Frye of the Maryland Natural Heritage Program and verified as *G. bigeloviana*: Suitland Bog, 10 June 1966, Mazzeo and Dudley 1394 (NA); Airport Bog, 13 July 1945, Hermann 11547 (NA). We believe that both *G. dumosa* and *G. bigeloviana* occur in Maryland but are very rare.

District of Columbia. We have seen one specimen apparently from this region: low woods, Steele 119 (DUKE); label pre-printed with "Plants of Washington D.C. and Vicinity." It is *G. bigeloviana* due to plant height and dense non-glandular hairs on leaf margins.

Delaware. Tatnall's (1946) species account is ambiguous, but it appears that he listed records for both taxa from New Castle and Sussex Counties. McAvoy and Bennett (2001) listed only *bigeloviana*—from the same two counties—and gave its habitat as Atlantic white cedar swamps. It is historical in the state. We believe that all Delaware records are *G. bigeloviana*.

Virginia. The online Atlas of the Virginia Flora (http://www.biol.vt.edu/digital_atlas) maps records of *G. dumosa* sensu lato from the coastal plain plus three montane counties: Augusta, Carroll, and Page. The Carroll County record is erroneous (T. Wieboldt pers. comm.). Carr (1938) cited specimens of *G. dumosa* var. *bigeloviana* from two locations in Augusta County; we have examined Carr 409 (GH, VA) and it is *G. dumosa*. We have not located Carr 138 (supposedly at VA), nor the Page County specimen. Nonetheless, we believe that all current Virginia records are *G. dumosa* but believe that *G. bigeloviana* may yet be found in the Dismal Swamp or a similar habitat in the southeastern sector of the state.

APPENDIX 1

SELECTED INLAND RECORDS OF *GAYLUSSACIA DUMOSA* SENSU STRICTO

There are many specimens and literature reports from the piedmont region of Virginia, the Carolinas, Georgia, etc.; we will not repeat them here. Instead, we focus on records from montane regions. **ALABAMA. Clay Co.:** Emory's Gap, 2000 ft, specimen at NCU. DeKalb Co.: Little River Canyon parkway, specimen at IBE. The draft Atlas of Alabama Flora maps G. dumosa in several counties in the hill country of east-central Alabama and N to Cullman, DeKalb, and Jackson Cos. **GEORGIA. Bartow Co.:** specimens at FSU and NCU. **Rabun Co.:** sandy slopes of Thomas Bald, 2500–3000 ft, reported by Small (1894); Rock Mountain, vicinity of Tallulah Falls, *A.B. Seymour 110* (DUKE). **NORTH CAROLINA. Catawba Co.:** hillside near Hickory, elev. nearly 2000 ft, reported by Small (1894). **Macon Co.:** Satula summit, Highlands, *T.G. Harbison s.n.* (NCU); top of Mt. Satulah, *M.B. Wilson 1860* (DUKE) [this is 4700 ft]. **Polk Co.:** dry ground, Tryon, *J.R. Churchill s.n.* (GH). **Transylvania Co.:** Horsepasture Gorge, pine woods, 2000+ ft, *C.L. Rogers 61341a* (NCU). **SOUTH CAROLINA. Oconee Co.:** several collections at CLEMS, NCU, USCH, from relatively low elevations in blackjack oak woods, xeric mixed oak woods, dry rocky slopes up to 1200 ft. **TENNESSEE. Coffee Co.:** Tullahoma, 1070 ft, *H.K. Svenson 10091* (DUKE, FSU, IBE). The Atlas of Tennessee Vascular Plants (Chester et al. 1997) maps it also in **Bledsoe, Cannon, Franklin,** and **Van Buren cos.,** all on the Cumberland Plateau. **VIRGINIA. Augusta Co.:** Shenandoah Acres, vicinity of Stuarts Draft, *L.G. Carr 409* (GH, VA). **WEST VIRGINIA. Raleigh Co.:** Flat Top Mountain. This record is discussed in detail by Strausbaugh and Core (1977) and is from a dry habitat with other species of coastal plain affinity. Harmon et al. (2007) map it also in **Nicholas** and **Summers cos.**

APPENDIX 2

RECORDS OF *GAYLUSSACIA OROCOLA*

NORTH CAROLINA. Buncombe Co.: swampy places, Biltmore, 25 May 1896, no collector (NCU), orig. det. dumosa. **Henderson Co.:** King Creek Bog, end of Mine Gap Road, montane sphagnum bog with dense woody vegetation and small openings, uncommon, 21 May 1993, *B.A. Sorrie 7306 with A.S. Weakley, B. Van Eerden, M.J. Russo* (NCU); near Brickton. n.d., *W.W. Ashe s.n.* (NCU); edge of Devil's Fork swamp, 2.5 mi E of Hendersonville, 18 Jun 1947, *G.W. McDowell 408* (DUKE); in swamps near East

Flat Rock, J.K. Small (NY), Type of *Lasiococcus orocola* Small, cited in Sleumer (1967); East Flat Rock, E.J. Alexander (NY), cited in Sleumer (1967); Flat Rock, 30 May 1886, *E.R. Memminger s.n.* (NCU); in bog 1 1/2 mi S of East Flat Rock, on rte. 176, 10 Oct 1937, W.C. Coker and party (NCU, 2 sheets); in a bog at East Flat Rock, near Hoot's Nursery, 6 Jun 1936, *D.S. Correll 5143 with H.L. Blomquist and K.H. Garren* (DUKE); Hoot's Swamp, *D. Samson 719* (NY), cited in Sleumer (1967). **Jackson Co.:** very top of Big Yellow Mountain, plants taller than on coast, 21 Aug 1936, *W.C. Coker s.n.* (NCU). **Macon Co.:** Satulah Mtn., Highlands, 21 Jun 1924, *W.W. Ashe s.n.* (NCU). **Transylvania Co.:** oak-hickory woods on rock outcrop, 2 mi N of Cedar Mt., 2 Jun 1952, *A.E. Radford 6090* (GH, NCU) [we believe there is a mis-labeling here; there are bogs two mi N of Cedar Mountain that support *Sarracenia jonesii, S. purpurea* var. *montana* and *Arethusa bulbosa* and other associates of G. orocola]; 1 mi NE of Frying Pan Gap, 23 Sep 1957, O.M. Freeman 57831 (NCU), mixed sheet with G. *baccata*; by creek in bog behind Pisgah Inn, 24 Jun 1955, *L. Walton 3551* (DUKE).

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